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<110> National Renewable Energy Laboratory

<120> Cellobiohydrolase I Gene and Improved Variants

<130> NREL 99-45

<140> 10/031,496
<141> 2002-01-14

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<170> PatentIn version 3.2

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   Val Ser Glu Val Gly Arg His Leu Gly Leu Leu Gly His Ser Ser
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tgc tca gtc ggc ctg cac tct cca atc gga gac tca ccc gcc tct gac        95
Cys Ser Val Gly Leu His Ser Pro Ile Gly Asp Ser Pro Ala Ser Asp
               20                  25                  30

atg gca gaa atg ctc gtc tgg tgg cac gtg cac tca aca gac agg ctc       143
Met Ala Glu Met Leu Val Trp Trp His Val His Ser Thr Asp Arg Leu
           35                  40                  45

cgt ggt cat cga cgc caa ctg gcg ctg gac tca cgc tac gaa cag cag       191
Arg Gly His Arg Arg Gln Leu Ala Leu Asp Ser Arg Tyr Glu Gln Gln
       50                  55                  60

cac gaa ctg cta cga tgg caa cac ttg gag ctc gac cct atg tcc tga       239
His Glu Leu Leu Arg Trp Gln His Leu Glu Leu Asp Pro Met Ser
   65                  70                  75

caa cga gac ctg cgc gaa gaa ctg ctg tct gga cgg tgc cgc cta cgc       287
Gln Arg Asp Leu Arg Glu Glu Leu Leu Ser Gly Arg Cys Arg Leu Arg
   80                  85                  90

gtc cac gta cgg agt tac cac gag cgg taa cag cct ctc cat tgg ctt       335
Val His Val Arg Ser Tyr His Glu Arg     Gln Pro Leu His Trp Leu
95                  100                 105

tgt cac cca gtc tgc gca gaa gaa cgt tgg cgc tcg cct tta cct tat       383
Cys His Pro Val Cys Ala Glu Glu Arg Trp Arg Ser Pro Leu Pro Tyr
110                 115                 120                 125

ggc gag cga cac gac cta cca gga att cac cct gct tgg caa cga gtt       431
Gly Glu Arg His Asp Leu Pro Gly Ile His Pro Ala Trp Gln Arg Val
               130                 135                 140

ctc ttt cga tgt tga tgt ttc gca gct gcc gtg cgg ctt gaa cgg agc       479
Leu Phe Arg Cys     Cys Phe Ala Ala Ala Val Arg Leu Glu Arg Ser
           145                 150                 155

tct cta ctt cgt gtc cat gga cgc gga tgg tgg cgt gag caa gta tcc       527
Ser Leu Leu Arg Val His Gly Arg Gly Trp Trp Arg Glu Gln Val Ser
           160                 165                 170

cac caa cac cgc tgg cgc caa gta cgg cac ggg gta ctg tga cag cca       575
His Gln His Arg Trp Arg Gln Val Arg His Gly Val Leu     Gln Pro
       175                 180                 185

gtg tcc ccg cga tct gaa gtt cat caa tgg cca ggc caa cgt tga ggg       623
Val Ser Pro Arg Ser Glu Val His Gln Trp Pro Gly Gln Arg     Gly
       190                 195                 200

ctg gga gcc gtc atc caa caa cgc gaa cac ggg cat tgg agg aca cgg       671
Leu Gly Ala Val Ile Gln Gln Arg Glu His Gly His Trp Arg Thr Arg
       205                 210                 215

aag ctg ctg ctc tga gat gga tat ctg gga ggc caa ctc cat ctc cga       719
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Lys Leu Leu Leu     Asp Gly Tyr Leu Gly Gly Gln Leu His Leu Arg
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ggc tct tac ccc cca ccc ttg cac gac tgt cgg cca gga gat ctg cga      767
Gly Ser Tyr Pro Pro Pro Leu His Asp Cys Arg Pro Gly Asp Leu Arg
    235                 240                 245

ggg tga tgg gtg cgg cgg aac tta ctc cga taa cag ata tgg cgg cac      815
Gly     Trp Val Arg Arg Asn Leu Leu Arg     Gln Ile Trp Arg His
250                 255                 260

ttg cga tcc cga tgg ctg cga ctg gaa ccc ata ccg cct ggg caa cac      863
Leu Arg Ser Arg Trp Leu Arg Leu Glu Pro Ile Pro Pro Gly Gln His
    265                 270                 275

cag ctt cta cgg ccc tgg ctc aag ctt tac cct cga tac cac caa gaa      911
Gln Leu Leu Arg Pro Trp Leu Lys Leu Tyr Pro Arg Tyr His Gln Glu
280                 285                 290                 295

att gac cgt tgt cac cca gtt cga gac gtc ggg tgc cat caa ccg ata      959
Ile Asp Arg Cys His Pro Val Arg Asp Val Gly Cys His Gln Pro Ile
                300                 305                 310

cta tgt cca gaa tgg cgt cac ttt cca gca gcc caa cgc cga gct tgg     1007
Leu Cys Pro Glu Trp Arg His Phe Pro Ala Ala Gln Arg Arg Ala Trp
            315                 320                 325

tag tta ctc tgg caa cga gct caa cga tga tta ctg cac agc tga gga     1055
    Leu Leu Trp Gln Arg Ala Gln Arg     Leu Leu His Ser     Gly
            330                 335                 340

ggc aga att cgg cgg atc ctc ttt ctc aga caa ggg cgg cct gac tca     1103
Gly Arg Ile Arg Arg Ile Leu Phe Leu Arg Gln Gly Arg Pro Asp Ser
                345                 350                 355

gtt caa gaa ggc tac ctc tgg cgg cat ggt tct ggt cat gag tct gtg     1151
Val Gln Glu Gly Tyr Leu Trp Arg His Gly Ser Gly His Glu Ser Val
            360                 365                 370

gga tga tta cta cgc caa cat gct gtg gct gga ctc cac cta ccc gac     1199
Gly     Leu Leu Arg Gln His Ala Val Ala Gly Leu His Leu Pro Asp
            375                 380                 385

aaa cga gac ctc ctc cac acc cgg tgc cgt gcg cgg aag ctg ctc cac     1247
Lys Arg Asp Leu Leu His Thr Arg Cys Arg Ala Arg Lys Leu Leu His
        390                 395                 400

cag ctc cgg tgt ccc tgc tca ggt cga atc tca gtc tcc caa cgc caa     1295
Gln Leu Arg Cys Pro Cys Ser Gly Arg Ile Ser Val Ser Gln Arg Gln
    405                 410                 415

ggt cac ctt ctc caa cat caa gtt cgg acc cat tgg cag cac cgg caa     1343
Gly His Leu Leu Gln His Gln Val Arg Thr His Trp Gln His Arg Gln
420                 425                 430                 435

ccc tag cgg cgg caa ccc tcc cgg cgg aaa ccc gcc tgg cac cac cac     1391
Pro     Arg Arg Gln Pro Ser Arg Arg Lys Pro Ala Trp His His His
                440                 445                 450

cac ccg ccg ccc agc cac tac cac tgg aag ctc tcc cgg acc tac cca     1439
His Pro Pro Pro Ser His Tyr His Trp Lys Leu Ser Arg Thr Tyr Pro
            455                 460                 465
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gtc tca cta cgg cca gtg cgg cgg tat tgg cta cag cgg ccc cac ggt     1487
Val Ser Leu Arg Pro Val Arg Arg Tyr Trp Leu Gln Arg Pro His Gly
            470                 475                 480

ctg cgc cag cgg cac aac ttg cca ggt cct gmc cct tac tac tct cag     1535
Leu Arg Gln Arg His Asn Leu Pro Gly Pro Xaa Pro Tyr Tyr Ser Gln
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tgc ctg taa agc tcc                                                 1550
Cys Leu     Ser Ser
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<213> Trichoderma reesei

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            20                  25                  30

Ala Glu Met Leu Val Trp Trp His Val His Ser Thr Asp Arg Leu Arg
        35                  40                  45

Gly His Arg Arg Gln Leu Ala Leu Asp Ser Arg Tyr Glu Gln Gln His
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Glu Leu Leu Arg Trp Gln His Leu Glu Leu Asp Pro Met Ser
65                  70                  75
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Arg Ser Pro Leu Pro Tyr Gly Glu Arg His Asp Leu Pro Gly Ile His
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Pro Ala Trp Gln Arg Val Leu Phe Arg Cys
35 40

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Cys Phe Ala Ala Ala Val Arg Leu Glu Arg Ser Ser Leu Leu Arg Val
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20 25 30

Arg Gln Val Arg His Gly Val Leu
35 40

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<213> Trichoderma reesei

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Gly Leu Gly Ala Val Ile Gln Gln Arg Glu His Gly His Trp Arg Thr
1 5 10 15

Arg Lys Leu Leu Leu
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Asp Gly Tyr Leu Gly Gly Gln Leu His Leu Arg Gly Ser Tyr Pro Pro
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Pro Leu His Asp Cys Arg Pro Gly Asp Leu Arg Gly
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Trp Val Arg Arg Asn Leu Leu Arg
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Gln Ile Trp Arg His Leu Arg Ser Arg Trp Leu Arg Leu Glu Pro Ile
1 5 10 15

Pro Pro Gly Gln His Gln Leu Leu Arg Pro Trp Leu Lys Leu Tyr Pro
20 25 30

Arg Tyr His Gln Glu Ile Asp Arg Cys His Pro Val Arg Asp Val Gly
35 40 45

Cys His Gln Pro Ile Leu Cys Pro Glu Trp Arg His Phe Pro Ala Ala
50 55 60

Gln Arg Arg Ala Trp
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Gly Gly Arg Ile Arg Arg Ile Leu Phe Leu Arg Gln Gly Arg Pro Asp
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Ser Val Gln Glu Gly Tyr Leu Trp Arg His Gly Ser Gly His Glu Ser
20 25 30

Val Gly

<210> 17
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<400> 17

Leu Leu Arg Gln His Ala Val Ala Gly Leu His Leu Pro Asp Lys Arg
1 5 10 15

Asp Leu Leu His Thr Arg Cys Arg Ala Arg Lys Leu Leu His Gln Leu
20 25 30

Arg Cys Pro Cys Ser Gly Arg Ile Ser Val Ser Gln Arg Gln Gly His
35 40 45

Leu Leu Gln His Gln Val Arg Thr His Trp Gln His Arg Gln Pro
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Pro Pro Ser His Tyr His Trp Lys Leu Ser Arg Thr Tyr Pro Val Ser
20 25 30

Leu Arg Pro Val Arg Arg Tyr Trp Leu Gln Arg Pro His Gly Leu Arg
35 40 45

Gln Arg His Asn Leu Pro Gly Pro Xaa Pro Tyr Tyr Ser Gln Cys Leu
50 55 60

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Val Ser Gln Val Gly Arg His Leu Gly Leu Leu Gly His Ser Ser Cys
1 5 10 15

Ser Val Gly Leu His Ser Pro Ile Gly Asp Ser Pro Ala Ser Asp Met
20 25 30

Ala Gln Met Leu Val Trp Trp His Val His Ser Thr Asp Arg Leu Arg
35 40 45

His Gly Arg Arg Gln Leu Ala Leu Asp Ser Arg Tyr Glu Gln Gln His
50 55 60

Glu Leu Leu Arg Trp Gln His Leu Glu Leu Asp Pro Leu Ser
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Val His Val Arg Ser Tyr His Gln Arg
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<213> Trichoderma reesei

<400> 21

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Arg Ser Pro Leu Pro Tyr Gly Glu Arg His Asp Leu Pro Gly Ile His
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Pro Ala Trp Gln Arg Val Leu Phe Arg Cys
35 40

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<400> 22

Cys Phe Ala Ala Ala Val Arg Leu Glu Arg Ser Ser Leu Leu Arg Val
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His Gly Arg Gly Trp Trp Arg Glu Gln Val Ser His Gln His Arg Trp
20 25 30

Arg Gln Val Arg His Gly Val Leu
35 40

<210> 23
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<212> PRT
<213> Trichoderma reesei

<400> 23

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<213> Trichoderma reesei

<400> 24

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Arg Lys Leu Leu Leu
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<213> Trichoderma reesei

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Asp Gly Tyr Leu Gly Gly Gln Leu His Leu Arg Gly Ser Tyr Pro Pro

1 5 10 15

Pro Leu His Asp Cys Arg Pro Gly Asp Leu Arg Gly
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Trp Val Arg Arg Asn Leu Leu Arg
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<213> Trichoderma reesei

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Pro Pro Gly Gln His Gln Leu Leu Arg Pro Trp Leu Lys Leu Tyr Pro
20 25 30

Arg Tyr His Gln Glu Ile Asp Arg Cys His Pro Val Arg Asp Val Gly
35 40 45

Cys His Gln Pro Ile Leu Cys Pro Glu Trp Arg His Phe Pro Ala Ala
50 55 60

Gln Arg Arg Ala Trp
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<213> Trichoderma reesei

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<400> 29

Leu Leu His Ser
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<400> 30

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1 5 10 15

Ser Val Gln Glu Gly Tyr Leu Trp Arg His Gly Ser Gly His Glu Ser
20 25 30

Val Gly

<210> 31
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<400> 31

Leu Leu Arg Gln His Ala Val Ala Gly Leu His Leu Pro Asp Lys Arg
1 5 10 15

Asp Leu Leu His Thr Arg Cys Arg Ala Arg Lys Leu Leu His Gln Leu
20 25 30

Arg Cys Pro Cys Ser Gly Arg Ile Ser Val Ser Gln Arg Gln Gly His
35 40 45

Leu Leu Gln His Gln Val Arg Thr His Trp Gln His Arg Gln Pro
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<223> The 'Xaa' at location 57 stands for Asp or Ala

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Pro Pro Ser His Tyr His Trp Lys Leu Ser Arg Thr Tyr Pro Val Ser
20 25 30

Leu Arg Pro Val Arg Arg Tyr Trp Leu Gln Arg Pro His Gly Leu Arg
35 40 45

Gln Arg His Asn Leu Pro Gly Pro Xaa Pro Tyr Tyr Ser Gln Cys Leu
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